U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1509

BEAN GROWING

IN NORTHERN IDAHO EASTERN WASHINGTON & EASTERN OREGON

DRY BEANS can be successfully produced in certain districts of northern Idaho, eastern Washington, and eastern Oregon without seriously interfering with the production of wheat, the major industry in these districts.

Thousands of acres that now lie idle as summer fallow each year are well adapted to bean growing. At slight additional expense and with practically the same equipment they can be made to produce about 600 to 800 pounds of beans per acre. Experience has shown that about as good cereal crops can be grown there after beans as after ordinary summer fallow. The cultivation of the bean crop replaces the work necessary to care for the summer fallow and leaves the soil in excellent condition for planting winter wheat. Beans are usually harvested in ample time to permit fall seeding. As with many other minor crops, however, the production of dry beans can be expanded far beyond our domestic needs.

There has been a substantial upward trend in both the production and the consumption of dry beans in the United States since 1922. Probably because of the effects of the depression and heavy production, bean prices dropped sharply during 1930, 1931, and 1932 (table 5).

This bulletin describes the methods followed by successful bean growers, showing that where sufficient moisture for crop production is present and few or no frosts occur between May 20 and September 15 beans have been incorporated into the cropping system with profit.

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BEAN GROWING IN NORTHERN IDAHO, EASTERN WASHINGTON, AND EASTERN OREGON

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Contents

DISTRICTS SUITED TO BEAN GROWING

BEAN GROWING may well be given greater consideration in certain northwestern districts. The districts lying along the foothills of the Craig Mountains and adjacent to the canyons of the Clearwater and Potlach Rivers in Nez Perce, Lewis, and Latah Counties, Idaho, and along the foothills of the Blue Mountains in Umatilla County, Oreg., and Walla Walla, Columbia, and Garfield Counties, Wash. are well adapted to the production of beans. There are also a few districts in Whitman, Spokane, and Stevens Counties, Wash., where the climatic conditions are favorable for bean growing. Because they are near the mountains, these districts receive enough rain to grow beans if proper cultural methods are practiced. Though only a limited area is especially adapted to this crop, a careful study of all the details of its production shows that there are thousands of acres now lying idle each year as summer fallow which might be used for producing beans as a row-tilled crop.

CONDITIONS FAVORING BEAN PRODUCTION

Two conditions are necessary for the successful production of beans: (1) The annual rainfall must be sufficient to produce a crop each year; and (2) the frost-free growing season must be approximately 120 days in length.

The deep ravines leading down from the mountains in these districts give protection from frosts during the growing season by furnishing excellent air drainage. Danger from frost generally increases with the elevation, but air drainage is the principal regulating factor. In parts of Nez Perce County, Idaho, where the deep canyons furnish good air drainage, beans are being grown successfully at an elevation

[1] Special acknowledgment is due Dr. K. H. W. Klages, Walter J. Virgin, Hobart Beresford, Elmer N. Humphreys, and Howard Roylance, of the Idaho Experiment Station, for valuable suggestions in regard to this revision.

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of 3,000 feet. In other parts of the same county that have a lower elevation but poor air drainage this crop cannot be grown on account of the late spring and early fall frosts.

Three other factors, largely within the control of the farmer, affect the success of the bean crop: The quantity of moisture stored in the soil at the time of planting, the methods used in growing and harvesting the crop, and the presence of the nodule-forming bacteria in the soil.

ADVANTAGES OF GROWING BEANS

In parts of Latah, Nez Perce, and Lewis Counties, Idaho, beans have been grown for 30 years, usually in alternation with wheat. Production there passed the experimental stage long ago. Experience shows that about as good cereal crops can be grown after beans as after an ordinary summer fallow. Cultivation of the bean crop replaces the work necessary to care for the summer fallow and leaves the soil in excellent condition for planting winter wheat. Beans are usually harvested in ample time to permit fall seeding.

Beans do not seriously compete with wheat for labor, and the two crops can be grown with practically the same equipment. From $300 to $375 worth of extra machinery is needed to plant, harvest, and cultivate from 70 to 80 acres of beans instead of cultivating the land as summer fallow.

MAINTAINING SOIL PRODUCTIVITY

The soils of the bean-growing districts are generally well supplied with the mineral elements necessary for plant growth. Under such conditions the maintenance of soil fertility will depend almost entirely on keeping up the organic matter of the soil. This is not easily accomplished when beans and the cereal crops are grown exclusively. In fact it has been thoroughly shown that the organic matter of the soil is gradually becoming depleted under the 2-year rotation of wheat and beans and that soil erosion is becoming more prevalent.

The permanency of the agriculture of the bean-growing districts to which this bulletin is applicable would be increased materially by the introduction of biennial sweetclover, alsike clover, or alfalfa into the cropping system.

Biennial sweetclover may be used as the soil-improving crop in a 3-year rotation by seeding it with small grain in the early spring. The grain is harvested in the usual way, and the next year the clover is used for pasture and for hay, or is plowed under in June as green manure. The following year the land is in beans. Where alfalfa is the soil-improving crop the land is devoted to the production of alfalfa continuously for 4 or more years and then to the growing of beans and wheat.

Alsike clover, if grown both for improving the soil and for seed, is a very satisfactory crop for the more humid part of the bean-growing districts of northern Idaho. The clover is planted with small grain in the early spring and is then used for 1 or more years for seed production, provided, of course, a satisfactory stand is obtained. After the clover is plowed up, the land is used for the production of beans, wheat, and other crops for 2 to 4 years before beans are grown again.

METHODS OF PRODUCTION

PREPARING THE SEEDBED

Success of the bean crop depends largely on the thorough preparation of the seedbed. Beans are not planted until danger of the late spring frosts has passed, about the first of June. This encourages slighting the tillage of the bean land until after the rush of planting all the other crops. To guard against such neglect, bean growers should have two very definite aims in view in handling the soil before planting the crop:

(1) The maximum amount of moisture should be stored in the soil at the time the bean crop is planted, because usually the rainfall that comes after planting time is rather scant. Moisture is lost from the soil in large quantities when volunteer wheat and weeds are allowed to make considerable growth in the spring before the land is prepared for planting beans.

(2) Tillage operations before planting the crop should destroy at least two crops of weeds and should prepare a moist, mellow, firm seedbed in which the seed will germinate quickly. With this accomplished, the handwork and cultivation necessary to grow the crop and keep it clean will be materially reduced.

The rush of the spring work on many farms makes it advisable to do considerable plowing in the fall as soon as the soil has become moist enough to be worked. Bean land that is plowed in the fall is left rough as it comes from the plow until spring. When dry enough in the spring, the soil is stirred once or twice with a disk or other suitable implement. A loose surface mulch is then maintained until planting time, to destroy weeds and prepare the seedbed. The amount and kind of cultivation required each year depend largely on the weather and soil conditions.

Many of the most successful bean growers of northern Idaho start the spring work by thoroughly disking the land to be planted to beans. No further tillage is given until the seeding of the small-grain crops is completed. Attention is then turned to the bean land, and its condition determines whether it is harrowed before it is plowed. Harrowing is usually good practice, but it is not done unless the advantages are very evident. The tillage given after the land is spring-plowed depends mainly upon the weather and the dampness of the soil. If the weather is fair and the soil is sufficiently dry as it comes from the plow, the land may be harrowed immediately and packed with a corrugated roller or cultipacker. But if the weather is damp and the surface soil is rather wet as it comes from the plow, the harrowing and packing are postponed until the soil is in proper working condition.

PLANTING

The time of planting varies from May 20 to June 10, according as the season is early or late. If the seed is planted too early, cold weather, together with an excessive quantity of moisture in the soil, may cause the seed to decay before germinating. Even if a good stand is obtained under such unfavorable conditions the crop usually develops and ripens very unevenly.

If the land to be planted is comparatively level and free from weeds and there is sufficient rainfall, the largest yields are obtained by planting the beans in rows 28 inches apart and dropping a bean every 2 to 3 inches in the row. If planted this way, the beans will ripen a little earlier and more evenly, and the quality will be more uniform. If the ground is so foul as to require extensive cultivation, the beans may be planted in checks with the hills 30 inches apart each way; about five beans should be planted in each hill. If planted in this way, the beans can be cultivated in two directions. Land that will require only a medium amount of hoeing may be planted in rows 30 inches apart with hills about 15 inches apart in the rows. The large-seed varieties require more pounds of seed per acre than those having small seed.

It is essential that the number of plants grown on a certain area be enough to maintain a proper balance between the soil moisture and the moisture requirements of the plants. If this balance is well maintained, the beans ripen evenly and a uniform crop is produced. In the districts in which beans are being grown at present, from four to six seeds in each hill produce the right number of plants. If fewer seeds are planted in each hill there is often moisture enough in the ground to keep the vines growing late in the fall and the late beans are sometimes damaged by early fall frosts. This problem must be worked out for each locality according to its soil and moisture conditions.

On really steep land the rows, as a rule, run straight up the hill. If the land to be planted has more than one steep slope the direction of the rows is often changed so that they will run straight up and down the steepest parts of the field. This makes planting, cultivating, and harvesting the crop comparatively easy. Although planting on the contour materially lessens the danger of soil erosion and loss of moisture by surface run-off when heavy showers occur, this method makes it very difficult to do a good job of planting and cultivating because of the slipping of the implements down the hill. Therefore contour planting on steep hillsides is not popular. However, the winter wheat that follows the beans should be planted on the contour to lessen the danger of soil erosion.

About 50 percent of the beans grown in the districts to which this bulletin is applicable are planted with ordinary grain drills. An 11-row grain drill having feed cups that will handle beans and grain tubes 7 inches apart can be adjusted for drilling beans in rows 28 inches apart by stopping up all of the feed cups except the second, sixth, and tenth. The drill is regulated to plant the seed from 3 to 6 inches apart in the rows. The disks, hoes, or shoes of the drill are held rigidly in place by being fastened securely to a board. This keeps the distance between the 4 rows uniformly the same as they are being planted.

An excellent type of bean and corn planter is shown in figure 1. This type of planter is used in planting approximately one-half of the bean crop. It may be adjusted to drop the seed either in hills or in rows from 28 to 44 inches apart. Either a grain drill or a four-row sugar-beet drill is generally used in planting the larger acreages.

A hand planter is often used if only small acreages are grown. The land to be planted is marked off in checks about 30 inches square, the beans being dropped at the intersections. An experienced man can plant from 4 to 7 acres per day with a hand planter.

The depth at which beans are planted depends on the character of the soil and the weather conditions. They are not planted so deep in dark, heavy soils as in the soils of lighter texture. Beans cannot be planted very deep during cold damp weather without injuring the stand. A safe plan is to plant just deep enough for the seed to lie in moist earth, for an even stand of strong healthy plants is one of the first requirements of a good bean crop.

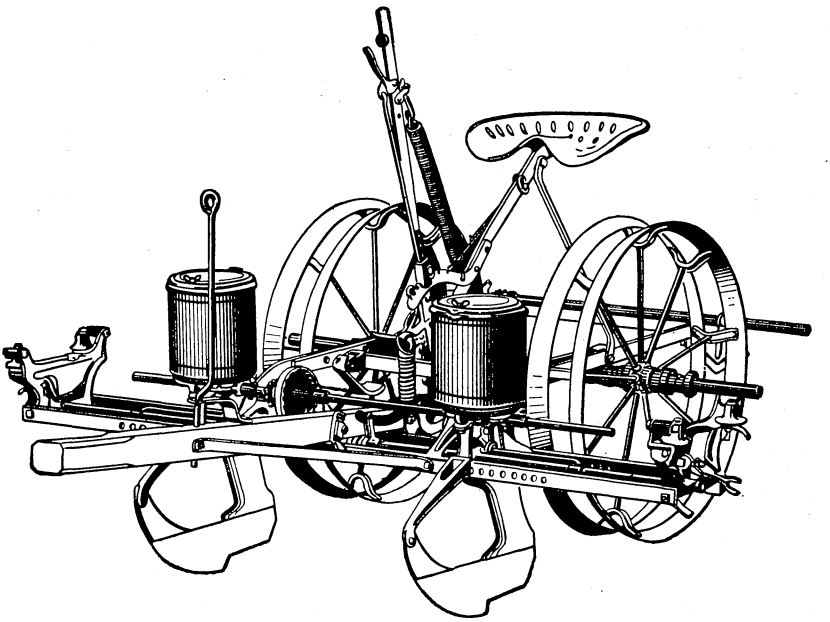

FIGURE 1.—A double-row bean or corn planter.

INOCULATION

For the successful culture of beans there must be nodule-forming bacteria in the soil. If these bacteria are present they form on the roots of the bean plants little lumps called nodules. By the aid of the bacteria living in the nodules the bean plants can assimilate atmospheric nitrogen. Without the help of these bacteria they must obtain their nitrogen from the soil. If the nodule-forming bacteria are not present in the soil they can be supplied by pure-culture inoculation. Pure-culture inoculation material is furnished to farmers by the University of Idaho, the Washington State College, and the Oregon State College. The United States Department of Agriculture furnishes it in small quantities for demonstrational purposes. Directions always accompany the pure-culture inoculating material.

CULTIVATION

A thorough preparation of the seedbed leaves the soil in excellent tilth, destroys most of the weeds, and materially lessens the cultivations necessary after the beans are planted. The number of cultivations depends upon so many factors that no fixed rule can be made to apply to every case. For this reason the statements that follow must be taken in a general sense.

Two or three days after the beans are planted, or just before the plants begin coming through the ground, the field is cultivated with a drag harrow. The harrow destroys the small weeds, levels the surface of the ground, and puts the soil in splendid condition to be cultivated as soon as the plants are large enough. If weed seeds germinate at the same time as the beans, the ground is harrowed again after the plants are up.

Some growers fear to use the harrow lest they injure the stand by breaking off the young plants. Very little damage is done, however, if the seedbed has been so well prepared that the ground is level and reasonably free from clods. Less damage will result if the harrowing is done when the surface soil and the bean plants are rather dry, as the young plants are more brittle when moist than when dry.

One harrowing, either before or after the plants are up, is enough if the ground is comparatively free from weeds. The harrowing should be done when the weeds are most easily destroyed. Two or three

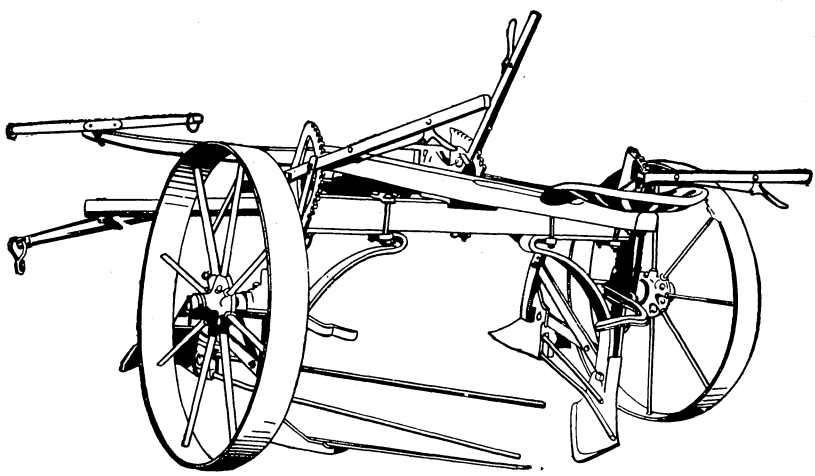

FIGURE 2.—Double-row bean cutter generally used for harvesting the crop.

additional cultivations during the growing season are usually necessary. All cultivation given after the crop is well started should be shallow, for the bean is a surface feeder, and deep cultivation is likely to disturb the rootlets of the young plants and thus diminish their ability to absorb moisture from the soil. It should be understood, also, that beans should never be harrowed or cultivated when the plants are damp or wet because of the danger of spreading diseases.

The two-row implements used in cultivating corn are the ones generally used in bean culture. To some extent four-row sugar-beet cultivators are used, and one-row cultivators are often used on small acreages. A four-row bean cultivator with four-row harvesting attachments that is pushed in front of a tractor is being perfected locally. In cultivating with the ordinary cultivator, sweeps are substituted for the shovels since they are better adapted to shallow cultivation. Level cultivation is practiced at all times. Cultivation is discontinued when the vines begin to bloom, for the flowers are easily

knocked off and late stirring of the soil tends to keep the plants growing, making them liable to damage by early fall frosts. Weeds near the plants are removed with a hoe.

HARVESTING

In the bean-growing districts of Nez Perce, Lewis, and Latah Counties, Idaho, the bean harvest usually begins about September 10. The date varies from August 25 to September 20, according to the season, the altitude, and the variety of beans grown.

A double-row bean cutter similar to the one shown in figure 2 is generally used for cutting the crop. One man with two good horses can cut from 12 to 14 acres a day with a machine of this kind. The double-row sled bean cutter shown in figure 3 is also a satisfactory implement, especially on steep land, as the runners tend to prevent slipping down the hill. This implement requires three horses, does good work, and can be made locally for much less than the cost of the implement shown in figure 2.

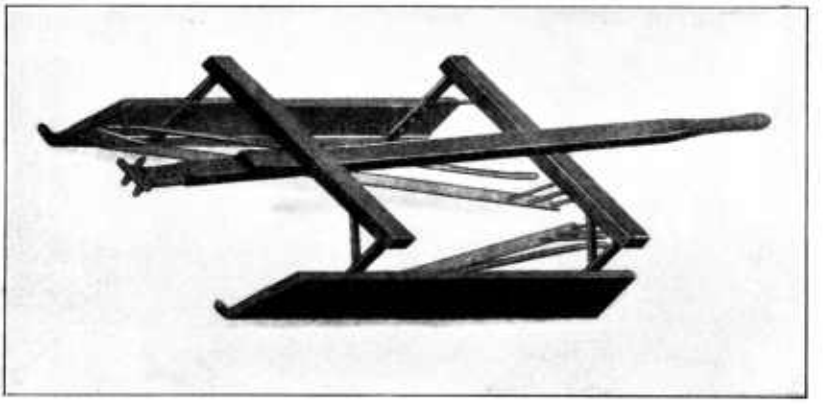

FIGURE 3.—A double-row sled bean cutter.

When the pods have turned yellow and before they have dried out, the vines are cut just below the surface of the ground. Either of the cutters here described cuts two rows at a time and forces the vines into one windrow. Two men with pitchforks follow immediately behind the cutter and place three of the windrows in one row of piles.

The plants are left piled in the field until the vines are thoroughly dry. It seldom takes more than 2 or 3 days for them to become dry enough to be hauled to the bean huller or stacked in the field or in sheds. Stacking materially lessens the danger of damage from rain. It is during the time the beans are lying in piles between cutting and threshing that there is danger of damage from rain. If they are stacked, such damage is not likely to occur as the stacking can begin within a couple of days after the beans are cut, and they are left in piles only a short time. Another advantage of stacking is that the vines go into a sweat soon after they are stacked and do not become thoroughly dry for 3 or 4 weeks after the sweating process begins. While in the sweat, the vines, pods, and seed become toughened, and

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there is less danger of cracking than when the beans are threshed directly from the field.

The side-delivery rake (fig. 4) is now used very generally in harvesting beans in Lewis, Nez Perce, and Latah Counties. Two rows of beans are thrown into one windrow by the bean cutter. After the beans are partially dry three of these windrows are thrown together with the side-delivery rake, making a windrow composed of six rows of beans. If good drying weather prevails, the beans may be hauled direct from these large windrows to the thresher, stack, or bean shed. On the other hand, if the beans become wet, the windrows may be turned over with the side-delivery rake, or they may be placed in piles. If a rain comes before the beans can be threshed or stacked, they are turned as soon as the ground dries. The pods should lie only a short time on the wet earth, as the seeds absorb moisture readily and may become discolored. Care must be used in handling the vines after they are thoroughly dry, for the pods crack open easily, and much loss may be caused by shattering.

FIGURE 4.—The side-delivery rake used in windrowing beans.

STACKING

The stacks are built on a layer of straw 12 or 14 inches thick, to keep the pods from coming in contact with the ground. The straw also catches the seeds that are trampled out during the stacking process. The beans are separated from the straw by running both through the huller. Stacks may be kept dry by covering them with heavy canvas or with straw. On the top of the stack the covering should be 12 to 15 inches deep. The straw is held in place by a network of wires or binder twine. Making the cover waterproof is important, for a leak may discolor the beans from the top to the bottom of the stack.

A bean crop may sometimes ripen so late in the season and rains may come so frequently that it is impossible to get the vines dry enough to stack in the usual way. Crops caught in this condition have been saved by being stacked in the driest condition possible in

narrow stacks about 10 feet wide. Poles, rails, or fence posts are placed in the stack, during construction, to secure ventilation. They are placed lengthwise of the stack and are separated by layers of beans from 18 to 24 inches thick. The stacks must be well covered as they must stand until the following spring or summer before the beans can be threshed.

THRESHING

Threshing is done with a bean huller (a machine designed to minimize the loss from cracking), with an ordinary grain separator, or with a pick-up combine. Good work can be done with a grain separator provided (1) the speed of the cylinder is reduced to 300 or 400 revolutions per minute (the speed depending on the diameter of the cylinder), (2) all but one row of the concave teeth and half of the cylinder teeth are removed, and (3) none of the threshed beans are allowed to pass from the elevator into the cylinder a second time. If these three precautions are observed and cracking still occurs, the elevator should be carefully examined and adjusted, for the cups of the elevators sometimes crack the beans severely.

An increasing proportion of the northern-Idaho bean crop has been threshed with pick-up combines in recent years. After the beans are cut, several rows are thrown together, either by hand or with a side-delivery rake (fig. 4), and the beans allowed to dry. The lately designed small pick-up combines can handle windrows containing from six to eight rows of beans. These machines do an excellent job of threshing if the land is not too steep.

MARKETING THE CROP

Cleaning and grading to get a uniform and attractive product are important in the marketing of dry beans. As far as the farmer is concerned, this preparation usually ends with the threshing operation. Many of the grain warehouses in the bean-growing districts are equipped with special machinery for this work. The farmer delivers his beans to the warehouse just as they come from the bean thresher, and about 6 percent of the thresher run is made up of culls and foreign matter. The farmer receives a load check, and his beans are kept in a separate pile. He then has the choice of selling them in this condition, which he usually does, or having them recleaned, scoured, separated into grades, and placed in sacks, which usually weigh 100 pounds each. After this work is done the farmer receives a negotiable warehouse receipt in exchange for his load receipts.

It is sometimes necessary to hand-pick the crop on account of discolored beans if the harvest season is damp, but weather conditions very seldom make hand picking necessary if the crop is handled properly. The operation of hand picking is made much easier by a small machine, operated by foot or other motive power, consisting of a canvas belt 7 or 8 inches wide passing over rollers driven at a low speed. The beans are fed to the belt from a hopper, and as they are carried along the pickers remove the discolored seed and foreign particles. The sound beans pass to the end of the canvas and drop into a sack or other receptacle. The usual charge for hand picking is 7 cents a pound for the damaged beans picked out.

KINDS OF BEANS GROWN

According to rough estimates, a small white bean locally known as Idaho Small White (flat type) makes up about 60 percent of all the beans grown in the northern-Idaho bean-producing districts at present (1939). Although this bean has been grown in certain of these localities for 20 to 25 years, it is only during recent years that it has reached first place. It is grown mostly for export trade, Cuba and Puerto Rico being the principal markets.

The Robust variety is second in importance and makes up approximately 20 percent of the harvested acreage. It is a strain of the Michigan Pea bean and was selected by the Michigan Agricultural Experiment Station. The Robust was introduced into northern Idaho some years ago because it is very resistant to mosaic. The rest of the beans grown in northern Idaho are chiefly Pintos, Small Reds, Red Kidneys, and several varieties of garden beans. The garden varieties are mainly grown under contract.

STANDARDS FOR BEANS [2]

It is of considerable value to growers to be familiar with the official United States standards for beans in order that they may improve their crops and be able to market them without suffering dockage losses. The official standards provide that the classes grown in the districts to which this bulletin is applicable (Small White, Large White, Western Red Kidney, and Small Red) may contain not more than a total of 2.0 percent of splits, damaged, other classes, and foreign material in grade No. 1; 4.0 percent in grade No. 2; and 6.0 percent in grade No. 3. It is further provided that of the 2.0 percent tolerance allowed in United States grade No. 1, not more than 0.5 percent shall consist of other classes of beans of a contrasting color, size, and shape, to the class being graded and that not more than 0.5 percent shall consist of foreign material like clods, vines, etc. By carefully selecting and producing their seed stock free from other classes (as outlined in the section of this bulletin which follows) growers can be reasonably certain that their products will meet the official grading requirements.[3]

IMPROVING THE CROP BY SEED SELECTION

In carefully studying a field of maturing beans a wide variation in the individual plants will be observed. It will be seen that some of the plants are mature, while others are still green; that some are heavily laden with well-filled pods, while others bear only a small number of seeds. It is possible to improve the crop greatly and decrease this variation by careful seed selection. The object of such selection is to increase the yield and vitality of the seed, to improve its quality, and to produce plants that will ripen evenly. In certain localities it is also desirable to select early maturing plants in order to shorten the time required for maturing the seed. It is impossible to obtain permanent results unless such selection is practiced every

[2] This section was prepared by Howard Roylance, Federal pea inspector, stationed at Moscow, Idaho.

[3] A copy of the Handbook of Official U. S. Standards For Beans may be obtained from the Agricultural Marketing Service, U. S. Department of Agriculture, Washington, D. C.

year, for bean plants have a strong tendency, if selection ceases, to return to the original type.

A practical method of seed improvement used by the most successful bean growers is as follows: In starting the work a large number of plants heavily laden with ripe pods are selected from the field at the time of maturity. The plants are taken from parts of the field where the stand is uniform and from soil that is representative of the general soil conditions. Plants from the outside rows or from places where the stand is poor are not representative and must not be used in seed selection.

The plants are pulled by hand, removed from the field, and carefully inspected to obtain the 25, 50, or 100 that are best. These are threshed individually, and the beans from each plant are put in separate paper bags, which are numbered.

The following year these selected seeds are planted by hand, a separate row for each paper bag. Toward harvest time this will be the most interesting plot on the farm, for the grower will soon see that when selecting his best plants the preceding fall in many cases he did not "know beans." A number of rows in this plot will be found to have produced progeny which are distinctly inferior in some respect. Here the advantage of these progeny rows will be apparent, for the grower is able to discard the bad rows entirely, whereas if he had not planted the seed from each selected plant by itself it would be practically impossible to remove the poorer types by roguing. One or more rows will be found to be decidedly better than the rest. All of these good rows should be saved for next year's seed plot. After a few rows which may be distinctly poor have been discarded, seed from the remainder of the plot can be used to plant the field.

By 1 year's individual selection a strain can be established which can be kept fairly pure by discarding all the inferior plants from the seed plot. The plot should be sown each year and should be large enough to furnish all the planting seed needed. The extra labor in threshing that this selection plan calls for comes at a time of year when it can be spared, since the selected plants can be stored unthreshed for a while. The labor of hand planting will be richly repaid by the greater producing value of a selected strain of beans.

BEAN DISEASES [4]

Three bean diseases are usually present in the beanfields of northern Idaho—common bean mosaic, bacterial blight, and curly top. Of these, common bean mosaic and bacterial blight are by far the most severe. Only an occasional plant is found to be affected with curly top.

COMMON BEAN MOSAIC

Common bean mosaic stunts the plant and causes mottling and various types of leaf malformation. Leaves affected with mosaic usually have irregularly shaped light- and dark-green areas of various sizes. There may also be considerable puckering, malformation, and other alterations in the shape of the leaf. Mosaic-affected bean leaves may be narrower and longer than normal leaves, with considerable downward cupping of the leaf due to unequal growth of the leaf

[4] This section was prepared by Walter J. Virgin, associate plant pathologist, Idaho Experiment Station.

tissues. This disease does not kill the plant, but it does materially reduce the yield.

Common bean mosaic is caused by a virus and is spread from plant to plant by insects, particularly aphids. The virus is seed-borne, and for this reason it appears in beanfields year after year generally in increasing amounts.

No known treatment of the seed or plants is effective in controlling mosaic. Certain varieties have been developed that are resistant to this disease, one of which is Norida, a small white bean developed by the Idaho Agricultural Experiment Station. This bean has not as yet replaced the very mosaic-susceptible small whites.

BACTERIAL BLIGHT

Two distinct organisms cause bacterial blight. Probably the most important in northern Idaho is the halo blight organism, so called because it produces a yellowish zone resembling a halo around new lesions on the leaves. The new lesions appear first as water-soaked spots on the under side of the leaves. Different lesions may gradually merge, producing a brown dead area and in time causing defoliation of the plant. Reddish-colored lesions may appear on the stems. Sometimes lesions form at the nodes of plants and, as they enlarge, encircle the stem thus producing a stem girdle, and the plant eventually topples over. Pods as well as seeds in the pods may also be affected. Minute water-soaked spots appear on the pods and gradually become larger. Later the spots become dry and sunken and take on a brick-red color. Often a gum-like bacterial exudate is present on the lesions.

If pod infection takes place when the pods are rather small, the seeds may never fully develop; but if the infection takes place later, the seeds may become somewhat discolored, having a varnish-like appearance which is easily detectable on white-seeded varieties but difficult to detect on the dark-colored ones.

The two bacterial organisms that cause bacterial blight produce symptoms that are hard to tell apart. At times these organisms may traverse the plant through water-carrying vessels or ducts and thus infect the seed where the bacteria can live over winter and infect the new plant when the seed germinates. It is also probable that the organism overwinters in the soil. This disease is favored by periods of rain or damp weather. The bacteria are spread from plant to plant and enter the stomata (breathing pores) of the leaves, stems, and pods.

No varieties of beans are resistant to bacterial blight. The Idaho Small Whites (flat type), the main variety grown in northern Idaho are rather tolerant to bacterial blight, whereas the Red Kidneys, which are frequently grown, are very susceptible, as are many of the garden varieties.

The use of disease-free seed is probably the most important recommendation that can be made for the control of bacterial blight. When such seed is planted, the extent of secondary spread of blight will be considerably reduced, since the centers of infection will have been eliminated. If a grower's seed is infected with bacterial blight it would be well for him to get seed from some other source, preferably southern Idaho, for bean seed raised in that territory is practically

free of bacterial blight. Another precaution is never to cultivate beans when it is raining or when they are wet with dew, for if there are any infected plants in the field, cultivating is sure to spread the infection to many more.

CURLY TOP

Plants affected with curly top are distinctly dwarfed. Young plants show the most pronounced symptoms on the trifoliolate leaves which pucker and curl downward, and show clearing of the leaf veins. On some varieties the young leaves are decidedly dwarfed and are darker green than normal. Cupping of the leaves sometimes continues until each leaf resembles a green ball. The young leaves often stop developing, then turn yellow, and curl downward. Such leaves are thicker than normal and very brittle, readily breaking off from the main stem. A plant thus affected generally dies before the pods develop. Plants infected late in the season do not always develop typical symptoms of the disease. This disease is not seed-borne.

Curly top is caused by a virus and is spread from plant to plant by the beet leafhopper (*Eutettix tenellus* Baker), frequently called the white fly.

This disease cannot be controlled except through the use of resistant varieties. Unfortunately, the Idaho Small Whites (flat type) are very susceptible to curly top. Red Mexicans are resistant to this disease, and Red Mexican U. I. 3 and U. I. 34, developed by the Idaho Agricultural Experiment Station, are, in addition to being resistant to curly top, resistant to mosaic.

BYPRODUCTS

The value of bean straw as a rough feed is not fully appreciated by all growers. Many farmers feed their bean straw, but much of it is burned immediately after threshing. Others allow it partly to decay in large piles and then use it as filling for ditches or as fertilizer. When not allowed to become damp or moldy, bean straw makes an excellent roughage for either sheep or cattle, and when fed in conjunction with grain is a good substitute for hay.

Bean straw is only a little inferior in feeding value to wheat, oat, and barley hay. The yield of bean straw per acre is ordinarily from one-half to three-fourths of a ton. The value of the straw per acre can be estimated closely by using the current prices of grain hay.

Little waste is caused from decay or discoloration of the seed during harvest, but sometimes there are many cull beans because of the splitting or cracking of the seed during threshing. The culls make good hog feed when thoroughly cooked and fed with other grain.

PRODUCTION IN COMPETING STATES

The commercial crop of dry edible beans of the United States, as shown in tables 1 and 3, is mainly produced in Michigan, California, Idaho, New York, Colorado, New Mexico, Montana, and Wyoming. The harvested bean acreage increased from 1,129,000 acres in 1922 to 2,159,000 acres in 1930, then declined to 1,431,000 acres in 1932, and again increased to 1,885,000 acres in 1935.

TABLE 1.—*Beans, dry edible: Harvested acreage, by producing States, 1928–38*

State	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938[1]
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*
Michigan	521	575	690	635	552	567	632	562	466	461	466
California	307	339	363	334	225	275	299	339	347	386	343
Colorado	374	376	450	351	221	365	174	435	287	244	312
New Mexico	150	170	220	190	140	155	25	165	152	184	166
Idaho	114	134	168	176	75	102	92	110	104	135	108
New York	78	103	132	132	126	147	147	152	142	158	161
Montana	40	47	41	29	20	28	15	26	14	21	16
Wyoming	23	29	36	40	20	33	32	42	40	59	48
Arizona	8	6	7	9	9	7	8	8	9	9	11
Nebraska	9	9	10	14	12	13	11	16	12	22	19
Maine	7	7	8	9	7	8	7	7	8	9	11
Wisconsin	6	7	8	7	6	5	7	6	3	4	2
Minnesota	5	5	6	7	7	7	7	6	2	3	3
Vermont	3	3	3	4	3	3	3	3	3	3	3
Kansas	6	22	13	9	7	13	------	7	4	------	------
Oregon	------	8	4	1	1	1	1	1	1	2	2
United States	1,651	1,840	2,159	1,947	1,431	1,729	1,460	1,885	1,594	1,700	1,671

[1] Preliminary.

TABLE 2.—*Beans, dry edible: Yield per acre, by producing States, 1928–38*

State	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938[1]
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Idaho	1,020	1,200	1,140	1,150	1,360	1,380	1,310	1,150	1,320	1,360	1,450
California	1,020	1,000	1,175	1,038	1,104	1,280	1,232	1,170	1,176	1,391	1,330
Montana	990	960	1,080	960	1,080	900	1,100	1,080	1,200	1,200	1,350
Wyoming	960	960	1,200	1,020	950	1,080	940	1,050	1,150	1,100	980
Maine	780	755	860	840	800	900	850	870	880	890	920
New York	790	720	570	930	750	720	820	740	600	800	900
Vermont	640	540	600	660	600	540	630	600	600	650	630
Nebraska	540	450	690	450	670	720	450	650	1,000	1,050	1,000
Michigan	660	560	420	560	920	730	661	910	570	940	980
Arizona	420	433	480	500	450	440	438	510	510	500	580
Minnesota	540	320	330	330	300	300	190	300	200	400	450
Wisconsin	510	430	402	240	390	390	370	480	390	370	420
New Mexico	240	594	270	400	250	340	270	400	290	370	320
Colorado	270	350	550	258	205	330	216	270	380	320	480
Kansas	360	285	720	330	360	360	------	300	180	------	------
Oregon	------	230	610	720	560	600	750	600	600	700	600
United States	640.5	667.3	654.6	663.3	769.0	738.6	780.3	759.8	715.5	916.6	913.7

[1] Preliminary.

TABLE 3.—*Beans, dry edible: Production by producing States, in bags of 100 pounds each, 1928–38*

State	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938[1]
	1,000 bags	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*
Michigan	3,439	3,220	2,898	3,556	5,078	4,139	4,178	5,114	2,656	4,333	4,567
California	3,132	3,391	4,264	3,467	2,484	3,520	3,684	3,965	4,081	5,369	4,563
Idaho	1,163	1,608	1,915	2,024	1,020	1,408	1,205	1,265	1,373	1,836	1,566
New York	616	742	752	1,228	945	1,058	1,205	1,125	852	1,264	1,449
Colorado	1,010	1,316	2,475	906	453	1,204	376	1,174	1,091	781	1,498
New Mexico	360	1,010	594	760	350	527	68	660	441	681	531
Montana	396	451	443	278	216	252	165	281	168	252	216
Wyoming	221	278	432	408	190	356	301	441	460	649	470
Nebraska	49	40	69	63	80	94	50	104	120	231	190
Maine	55	53	69	76	56	72	60	61	70	80	101
Minnesota	27	16	20	23	21	21	13	18	4	12	14
Wisconsin	31	30	32	17	23	20	26	29	12	15	8
Vermont	19	16	18	26	18	16	19	18	18	20	19
Arizona	34	26	34	45	40	31	35	41	46	45	64
Kansas	22	63	94	30	25	47	------	21	7	------	------
Oregon	------	18	24	7	6	6	8	6	6	14	12
United States	10,574	12,278	14,133	12,914	11,005	12,771	11,393	14,323	11,405	15,582	15,268

[1] Preliminary.

The average yield of beans per acre by producing States is shown in table 2. The lowest yields are usually obtained where the rainfall is scant and where the crop is grown without irrigation, whereas the highest yields are generally obtained under irrigation.

Total commercial-crop production and production by producing States are shown in table 3 for the period 1928–38 in terms of bags of 100 pounds each. During this period total production increased from 10,574,000 bags in 1928 to 15,582,000 bags in 1937. The total production for 1938 has been estimated at 15,268,000 bags.

Total domestic exports of dry edible beans (beans produced in the United States) exceeded total imports 517,000 bags of 100 pounds each in 1920 and 4,000 bags in 1921. Imports, on the other hand, exceeded domestic exports on an average by 573,000 bags annually from 1922 to 1932. In like manner the total imports of beans for consumption in the United States from 1933 to 1937, inclusive, exceeded domestic exports on an average by 214,000 bags annually. Thus, it is seen, considerably more beans have been imported into the United States since 1921 than have been exported.

TABLE 4.—*Beans, dry edible: Production by commercial classes in bags of 100 pounds each, 1928–38*

Class	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938 [1]
	1,000 bags	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*	*1,000 bags*
Peas and Medium White	3,358	3,346	3,141	3,856	5,403	4,391	4,396	5,003	2,599	4,471	4,676
Great Northern	1,387	1,747	2,011	1,956	992	1,440	1,084	1,441	1,470	2,162	1,671
California Small White	424	415	489	429	226	417	402	351	502	1,024	540
White Marrow	103	135	180	201	101	128	139	154	125	129	152
White Kidney	29	42	41	111	58	80	142	109	43	104	65
Total white	5,301	5,685	5,862	6,553	6,780	6,456	6,163	7,058	4,739	7,890	7,104
Red Kidney [2]	642	442	376	651	465	573	563	631	675	793	923
Small Red	282	393	520	474	250	279	267	292	204	266	303
Cranberry	106	113	128	159	94	151	242	413	223	200	274
Pink	575	619	625	436	516	595	485	843	447	454	637
Yellow Eye	95	100	81	137	78	105	174	146	100	149	155
Pinto	1,402	2,319	3,096	1,687	859	1,828	579	2,147	1,708	1,684	2,344
Black Eye	428	514	852	459	275	587	525	615	765	857	512
Total colored	3,530	4,500	5,678	4,003	2,537	4,118	2,835	5,087	4,122	4,403	5,148
Standard Lima	890	987	1,102	1,064	872	943	1,072	989	1,119	1,419	1,395
Baby Lima	401	486	696	663	322	630	708	536	876	1,142	864
Total Lima	1,291	1,473	1,798	1,727	1,194	1,573	1,780	1,525	1,995	2,561	2,259
All other	452	620	795	631	494	624	615	653	549	728	757
Total	10,574	12,278	14,133	12,914	11,005	12,771	11,393	14,323	11,405	15,582	15,268

[1] Preliminary.
[2] Includes Dark Red Kidney.

TABLE 5.—*Beans, dry edible: Seasonal farm price per 100 pounds, 1922–38* [1]

Year	Idaho	Michigan	Colorado	United States	Year	Idaho	Michigan	Colorado	United States
	Dollars	*Dollars*	*Dollars*	*Dollars*		*Dollars*	*Dollars*	*Dollars*	*Dollars*
1922	5.50	6.10	5.40	5.82	1931	1.70	1.80	1.40	2.13
1923	5.80	4.80	4.55	5.36	1932	1.50	1.50	2.20	1.98
1924	5.80	5.20	4.60	5.64	1933	2.20	2.25	2.90	2.78
1925	4.80	4.15	3.85	5.00	1934	3.15	2.75	5.50	3.52
1926	4.60	4.40	4.85	4.99	1935	2.50	2.25	2.75	2.93
1927	5.00	5.90	5.20	5.55	1936	4.75	6.00	4.45	5.38
1928	6.40	8.00	5.50	7.33	1937	2.45	2.25	3.80	3.07
1929	6.00	6.70	4.95	6.77	1938	1.80	1.95	3.20	2.63
1930	3.80	4.35	2.80	4.20					

[1] Idaho prices reflect fairly well the farm prices for the Great Northern; Michigan prices, those for the Pea bean; and United States prices, those for all dry beans grouped together.

PRODUCTION BY COMMERCIAL CLASSES

The bean crop as a whole is made up of a number of distinct classes which enter into a somewhat complex trade (table 4). The normal demand for several of these classes has become so fixed and well-defined that they are only indirectly competitive. Some kinds of beans are preferred for baking, others for soup, and others in preparing canned products. Furthermore, different markets frequently have varying preferences. For these reasons the price of a particular class of beans may react more strongly to the supply of that class than to the supply of the bean crop as a whole.

The beans grown in northern Idaho, the principal district to which this bulletin is applicable, are shipped to Cuba, Puerto Rico, the Pacific coast, and the middle-western and the eastern markets, where they compete mainly with the Pea bean, grown chiefly in Michigan and New York; with the Great Northern, produced principally in southern Idaho, Montana, and Wyoming; with the Small and Large Whites, grown in California; and with the Pinto, grown in Colorado and New Mexico. When the spread in price between the different classes is considerable, the beans produced in northern Idaho come into competition with other kinds of beans. Table 5 presents December 1 farm prices of beans for Idaho, Michigan, Colorado, and the United States as a whole. The Idaho price reflects fairly well the price of the Great Northern, the Michigan price that of the Pea bean, the Colorado price that of the Pinto, while the United States price represents the average price of the bean crop as a whole.

Production of dry beans can be expanded greatly and quickly in practically all producing areas. This was demonstrated during the World War, when the harvested acreage was increased from 875,000 acres in 1914 to 1,821,000 acres in 1917. To stabilize the industry the acreage planted to the respective classes of beans in the various producting areas should be adjusted carefully to the market requirements of the several classes.

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